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METROPOLITAN
WATER SUPPLY,

Present and Future ;

IN FOUR LETTERS

TO THE

"DAILY NEWS" NEWSPAPER.

BY JOHN LOUDE TABBERNER.

London :

HENRY RENSHAW, No. 356, STRAND.

1850.

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With the Author's respectful compliments.]

METROPOLITAN WATER SUPPLY, *Present and Future;*

IN

FOUR LETTERS TO THE "DAILY NEWS" NEWSPAPER.

- I. *Showing that Water is not a commercial property, and ought not to be subjected to commercial control. That the Metropolitan supply should be a public institution, administered by a public commission, possessing powers under an Act of Parliament, as suggested.*
- II. *Showing the present monied position of the existing companies; the cost of their present supply to the public; the value of their present plants and the value of all existing interests in the present Water Supply; with an explanation how the whole may be fairly purchased and paid for by the public; and how an improved supply may be obtained, and the whole Metropolitan Water service permanently secured as public property, without requiring any advance of money, either from the Government or the Rate-payers, and without increasing the present average rate per house.*
- III. *Showing the quantity of Water as at present supplied to the inhabitants from all sources; and the various means available for affording an improved continuous service to every room in every house throughout the Metropolis; at the same time establishing an abundant supply for all-sanitary purposes.*
- IV. *Showing the qualities of the chalk and river Thames Water respectively; and explaining why the water of the chalk formation, beneath and around London, differs in its constituents in different places.*

By JOHN LOUDE TABBERNER.

LONDON:

HENRY RENSHAW, No. 356, STRAND.

1850.

LONDON:
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P R E F A C E.

TO THE LONDON PUBLIC.

The series of Letters I now respectfully submit for general perusal, were recently written to the *Daily News* newspaper, and were called forth by the current events pertaining to the question of an improved supply of water to the Metropolis. They advocate the principle of public control I have long striven to establish over the distribution of water to the inhabitants of London, and which I am emboldened to believe is universally approved.

Without that egotistical presumption some are always forward to attribute to faithful and confident enunciations, I beg to say that if the principles upon which I have based the suggestions I have ventured briefly to offer should be authoritatively acted upon, a lasting and growing vitality will be imparted to the physical strength of the people, which will invigorate and improve the social condition of society, and elevate the moral worth of all; for I hold it as a *truth* which cannot be too deeply impressed upon the mind of every individual, especially upon the wealthier classes, that only in proportion to the efforts made to stay the moral degradation of the suffering multitude, by affording means to make their homes habitable and domestic comforts attainable, whereby their physical powers may be improved, will industrial energy strengthen and thrive, vice and crime appreciably cease, pauperism and sickness diminish, parochial and national burthens decrease, and the

respective grades of society continue to be acknowledged and respected. Example is a first incentive to moral reformation; and until the parent is physically stimulated and morally reformed, to an active sense that it is his first natural duty to nurture his offspring in virtuous and honest habits, no sound moral or intellectual progress will be manifest amongst the lower orders. The root and the stem must be made healthy before the branches will blossom or bear fruit; or where, from irretrievable decay, the former accomplishment is rendered impossible, the latter must be entirely lopped from the parent trunk, and, in the absence of natural support and protection, must be afforded comprehensive and enlightened public succour.

That the means of cleanliness—AN UNINTERMITTENT SUPPLY OF WATER, *the first element of physical improvement, and the strongest bulwark against disease*—is the very fulcrum of all sanitary ameliorations must be, and is, universally admitted; and as such, therefore, it should be a subject of the first consideration in contemplating effective and substantial sanitary improvements.

I have not, in the annexed Letters, adverted to other questions necessary to be considered in perfecting an efficient sanitary code; but my conviction is, that the drainage and sewerage, paving and lighting, and the erection of metropolitan buildings, should be under the administrative powers of the same commission as the water supply—at least, if not under one and the same commission, they should respectively be under the control of such responsibly

constituted commissions as I have suggested to administer the water service.

I would be distinctly understood, in making these few remarks, as supporting literal local government *over all institutions* requiring for their support and conduct *direct local rates* ; for I contend that as the inhabitants pay for all such administrations, they are entitled to have a direct voice in the expenditure thereof; and if the control of such expenditure be solely vested in an irresponsible power to the *rate-payers themselves*, I further contend that in such an instituted power is perpetrated an unconstitutional infraction of the civil privileges of the public. I am aware the received supposition is, that *no* irresponsible power can exist under our constitution,—that *through* parliament *all* commissions appointed by the government are made responsible to the people,—and in such sense, in fact, is the political acceptance of such commissions; but, literally speaking, and indeed in a practical sense, commissions so appointed by the government to administer *local affairs* are *irresponsible* to those directly and immediately affected by their acts. So *indirect*, so *remote*, is the responsibility of such commissions to the rate-payers *that it is not only understood as a matter of course to be, but really is, merely nominal*.

I also earnestly maintain that it has been, and, while England is naturally great within herself, ever will be, through our local institutions that the constitution of our common country derives its civil strength and political power: to destroy, impair, or circumscribe those local institutions,

or the principles upon which they are founded, would be taking away the internal pillars which support the structure of the constitution, leaving only the bare external portions of the fabric, first to totter, and then to fall.

But while I seriously and sedulously advocate local government as a civil right, and as an invulnerable safeguard to our international prosperity and peace, I am not insensible to the growing abuses it is subjected to, as the wealth of the general community augments, and as the population and civil responsibilities of each municipality increases; and as these respective developments of civilisation naturally enlarge, it is essential, having due regard to a fair representation of all interests, to centralise the local administration of all large cities within one, or as few common scopes of action as possible, so as to secure economy, uniformity, and efficiency in all municipal operations. And I further submit, that just in proportion as it is essential to have a check upon the Government's expenditure of the public revenue through the Commons' House of Parliament, so it is expedient to have a check upon local administrations to preclude the possibility of abuses, through a counter responsibility;—such or similar to that indicated in the following correspondence.

I am faithfully yours,

JOHN LOUDE TABBERNER.

6, *Essex Street, Strand,*
London, March 30th, 1850.

WATER SUPPLY TO THE METROPOLIS.

TO THE EDITOR OF THE "DAILY NEWS."

SIR,

Believing your valuable columns are always open for the promotion of any important public good, and knowing the subject upon which I am about to offer some remarks and suggestions to be of importance, and believing that my observations will do no harm, but may do some good, and not prove altogether uninteresting, I beg respectfully to ask the favour of your affording them insertion in your paper.

It is very probable I should not now have been induced to trouble you, but for the extensive circulation of an anonymous handbill, headed "Water Supply of London, and Government Centralisation and Parochial Management *versus* Competition by Private Enterprise," to which my attention has been directed, and which has evidently been published, if not directly, indirectly, by the London (Watford) Spring Water Company, lauding the Watford scheme, reprobating other schemes before the public, and denouncing the proposition to place the control of the general water supply under a public commission, responsible to the inhabitants, and in which allusion is also made to myself.

The London (Watford) Spring Water Company are using every effort to find a nook in the public mind for the sanction of another water monopoly, in addition to those we already have, for some generations past, been struggling under; and with all that professed disinterestedness and transcendent ebullieny which so pre-eminently characterised some of the existing companies when they first sought to raise their heads to char-

tered authority and dignity, the promoters of this Watford project are, by the use of the most complacent professions and specious promises to the public, strenuously endeavouring to establish their wily hopes in the formation of a new company, under the same exclusive and oppressive principles as the companies now in existence possess, in direct violation of the first and most important domestic interests of the London community. It is with the view, therefore, of once more urging public attention to the form of control which any new scheme or measure may seek to assume over the water supply that I am induced to address you. The sole point in the great question of reforming the water service of the metropolis, which the public should and must be critically jealous upon, is that of control. As far as an improved supply of water extends no apprehension need exist, for we have a superabundance available to our wants. The difficult part of the question, and that which must be attended to by the public is, what administrative power shall be established over the water service for the future?

The Watford scheme I object to for more reasons than one, but more particularly because its promoters have brought it forward under the auspices of a trading company; but why I entertain other objections to the scheme will be seen in the course of my observations.

I know many are opposed to me in the views I have formed as to water not being a commercial, but on the other hand being a public property, and hold the diametrically opposite opinion, *viz.*: that it ought to be supplied to the public by trading bodies, under what they denominate the wholesome and equitable influence of commercial competition. In my past advocacy of the views I entertain, all motives, excepting fair and just ones, have been attributed to me by my adversaries. They say that I am about to establish an eight-headed monopoly, a long-armed centralisation, a jobbing government control, and an irresponsible commission, and many other equally absurd and misnomered intentions they charge me with, and also those who hold similar views to myself; notwithstanding I stand by the

views I published in 1847, and no one opponent has yet successfully advanced one reasonable argument against them. I then contended, as I now do, that water is a first element of life, and as such should be, with light and air, municipally considered and provided in all densely populated communities. These three elements of life are first attributes of man's subsistence, without which it is impossible he can live. They are primary components which, in the incomprehensible wisdom of God, are ordained as means of vital power in sustaining animal and vegetable life, and to such beneficent ends they should be duly, abundantly, and freely applied ; and not made the means of a sordid, commercial, and national tribute, to the circumscription, indeed to the destruction of the poor man's domestic comforts and health, and consequently his moral and industrial usefulness. I am aware, at this point of my argument, it will be contended that I might with just the same amount of reason on my side, say that bread, and all articles of food upon which man subsists should be considered and treated as public, and not as commercial property. Here I ask to be distinctly understood, for it is here the gist and value of my assumption, and also that of my opponents, must be tested. The absolute production of air, light, and water, does not require the labour, skill, and care of man. They are, as I have before said, first attributes of man's subsistence, and stand alone as the production of divine arrangements for the sustenance of animal and vegetable vitality. On the contrary, all other necessities for man's subsistence requires his own labour and skill to produce them, and as his labour and skill are his natural means whereby he is enabled to provide for all his natural and artificial requirements, and as the amount and quality of both the labour and skill of every individual vary, one producing more and another less, all articles, whether of food or otherwise, first dependent upon that labour and skill, should, under such commercial codes as should neither stultify the vigour nor destroy the buoyancy of industry, nor oppress social or political freedom, be subjected to that wholesome competition which legitimate

demand and supply alone ought to regulate ; consequently, I contend that it is the duty of all governments to provide such social arrangements as shall afford to man in due amount those first elements of subsistence,—air, light, and water—for the support of his life and health ; and, on the other hand to provide such equitable national and commercial laws as shall best create and protect a mode and market of exchange for the disposition of all those surplus products which accrue beyond the first and natural wants of man, from the industrial application of his life and health. I therefore affirm, that water is not a commercial property, and ought not to be made a commodity of sale ; and where, as in all large towns and cities it is essential to subject its distribution to municipal regulations, it ought to be afforded to the inhabitants as public property, at the bare cost of conveyance ; and I again repeat, that it is a first duty of a government to enact such laws as will provide such municipal regulations.

Prior to the year 1580, the water supply of the metropolis was ever considered of paramount importance to the health and comfort of the inhabitants, and was placed under the management of the public authorities, whose duty it was to provide such means as would afford an unlimited supply of water to rich and poor alike—not as a commercial but as a public property ; and it has been a culpable oversight on the part of our legislature, amounting to a positive abrogation of an inalienable, indefeasible natural right, in subjecting, in the first instance, the distribution of water to the people, to commercial caprice ; and, in the second instance, to an oppressive, exclusive monied monopoly, against the greatest knavery of which no power of appeal, no means of redress is afforded the public ; and I have said again and again, and now repeat my unalterable conviction, that to grant any fresh powers whatever to the present, or to any new companies, would be enlarging gross legislative errors, and extending the field of a disgraceful monopoly, and strengthening a power directly opposed to social progress. And however sanguine of success the Watford Com-

pany or any other water company may be, as to obtaining further powers from parliament to construct new works under their own exclusive domination, I do sincerely hope, as I believe, they will not succeed.

I will now just take a pounds, shilling, and pence view of the question, and I think I can, from deductions under that head alone, also prove that water is not a commercial property. The history of the existing water companies has of late been so frequently afforded by different parties, that I need not now allude to it beyond what is absolutely essential to substantiate my position. It will be remembered that up to the formation of the East London Company little or no competition existed between the old water companies, excepting now and then a little spirit of antagonism might have exhibited itself; up to that time their days were palmy and their gains golden. It was only after the establishment of the East London, Vauxhall, West Middlesex, and the Grand Junction Companies, that competition in the distribution of water had a fair trial. It commenced in earnest in 1810, and lasted till 1820. During that time two or three companies laid their respective pipes through the same streets, and as time passed on they in many parts in the spirit of opposition to, or I will rather say of "competition by private enterprise" with each other, they offered their water to some for a very small charge, and to others even without any charge, in order to obtain customers; but what did it all end in? They discovered at last that the commodity they were supplying to the inhabitants cost each company about the same—most of it being from one and the same source of supply—and that the working expenses of distribution were about the same to each; and that so long as they went on opposing each other, while one possessed no practical advantage over another, they could gain nothing for themselves, consequently that the capital they had invested in these at first supposed lucrative undertakings made no profitable returns under the principles of commercial competition; they, there-

fore, determined that the commodity they had to dispose of to the public could not be produced as a commercial property, and, consequently, could not be subjected to legitimate commercial regulations; in fact, that it would not bear competition. The very serious consequence of all this to the inhabitants will be manifest. Under the influence of "competition by private enterprise," several sets of pipes had been laid through the same streets, the expense of engine power and working contingencies multiplied accordingly; and the very significant question which now arose was, how was the capital which had been so recklessly invested, under wrong principles, in constructing two or three plants, where one, under proper municipal regulations, would have answered all purposes, to be made to pay a dividend to the shareholders? I think at this moment of the reign of our most gracious sovereign the Queen, I need not attempt to show how this very important question was at that time answered by the shareholders of the companies. The inhabitants have, indeed, been very impressively taught how the then very difficult problem was solved. It is too well known that in many parts two or three sets of pipes have ever since been lying underground perfectly useless, while the inhabitants have been called upon and made to pay dividends upon the investment. I doubt not but every householder in London is by this time grievously acquainted with the fact that, when the water companies found themselves in a state approaching bankruptcy and ruin under the operation of commercial competition in the disposition of a commodity which, they at length discovered, was not a legitimate article of commercial enterprise, the only alternative left to them was to establish an exclusive district of the metropolis and a monopoly to each, capitalise all their respective outlays, and levy such a rate upon the inhabitants as would enable them to reimburse all the losses they had sustained in "competition by private enterprise;" and to declare a dividend for the future upon all the capital they had so uselessly invested, thereby increasing the price of water to each householder three and fourfold above a

fair and just charge ; and in reality making the public pay ten years' arrears of profits to each of three or four companies, and ever since any amount of rates they respectively choose to exact. It is well known that, since this exclusive arrangement among the companies was effected, the water rates in no instance have been once reduced ; on the other hand, they have been uniformly increased, till both the oppression and the charges have become intolerable. It is also well known that the public has no voice or redress against any further increase of charge or any abuse of power these monopolists may choose to inflict upon it.

Thus have the inhabitants been virtually tied, hand and foot, ever since 1820, while the companies, under the security and protection of powers obtained, based and granted on wrong principles, have taken out of their pockets any amount of money they have thought proper to help themselves to, till they have well stored the purses their competition against each other emptied ; and, at the same time, made the inhabitants pay for all subsequent extensions of their respective works, the outlay of which they have also capitalised, in addition to all former outlays, whether in the construction of works long since worn out or otherwise, upon the whole of which they now make the helpless public pay comfortable dividends and bonuses to their respective shareholders. All this has been, and is, the inevitable result of short-sighted legislation, and of the companies, in their covetous cupidity, discovering that water could not be dealt with as a commercial commodity ; and that it could only be made to pay commercial profits, and usurious gains, under the exclusive administrative powers of one of the most infamous monopolies history has to record. Infamous, I repeat, for it is to that exclusive combination of individual aggrandisement, the fearful, I will add awful, amount of physical, and consequently moral, degradation, which abounds in, and taints every alley and street of the metropolis, is to be in a very great measure attributed, and which has tended more than anything again to progressively increase, with the growth of popu-

lation, the intemperance, improvidence, and misery of the lower classes; the intellectual elevation of whom it will be worse than folly to attempt, till their physical comforts are better municipally cared and provided for.

The above are my grounds for opposing the establishment of any new Water Company, or extending any new powers to the present Companies; and indeed the substance of my reasons for urging the entire abolition of all the latter, and for endeavouring to establish the general water supply as a public institution on a self-supporting principle, under the control and management of a public elective commission; and I will beg briefly to state what my suggestions are in reference to improving the water supply, and the administrative powers necessary to be established; and to show the fiscal benefits which will accrue to the public by an enlightened administration of such a public institution.

In thus enunciating my views necessary brevity must preclude my enlarging on the general question; I shall therefore merely say that I would make the water service to every house and building, of whatever description, a part of the ground freehold, for this simple reason. No man would think of building any house without he could obtain water thereto; ergo, no site can be eligible for building purposes without a supply of water:— If a man therefore possesses building property or purchases a site of land on which he purposes building, I would compel him to have and pay for a water supply to it; and I contend it is owing to the absence of a regulation of this kind in the construction of our towns and cities, that the greater portion of our present sanitary evils and difficulties have arisen. I would deal fairly and justly with the existing Companies: I would purchase all their plants, and apply the same to sanitary purposes. And I would establish a new continuous service throughout the metropolis for domestic purposes. All this I would do, and I will show how it may be done, without asking government or the inhabitants for one shilling; while at the same time I will show that the average rates, as now charged

by the present companies, would not be increased one fraction, but considerably reduced.

The practical way to set about accomplishing my suggestions is this. The government should either introduce or support a measure through parliament for affording an improved supply of water to the metropolis. Such a measure should—1st, provide for a Commission composed of property qualified rate-payers—say four or six out of every metropolitan electoral district, to be elected by the rate-payers, one-third of the whole body to retire every three years, and to be made eligible to be re-elected; thus would be provided a body corporate directly responsible to the inhabitants, which would not be subjected to too frequent a change of members as to render the commission inefficient and inoperative. This commission should be unpaid, to which I would add two unpaid government commissioners, through whom the commission should be made responsible to the government. This commission should have the power to appoint a permanent working committee of three or five practical men, not members of the commission, but as paid public servants, who should be compelled to devote their whole time and attention to the duties of the commission, which committee should be aided by one government inspector. Thus would the commission be made directly responsible both to the inhabitants and to the government, and the possibility of jobbing on either side precluded; while, at the same time, the best means of securing efficiency, uniformity, and economy in its operations would be attained.

2nd. The measure should provide for the establishment of a uniform rate throughout the metropolis, including all its suburban districts, on all existing building erections according to the assessment for the time being, which rate should be charged on the fee-simple of the property, and powers afforded to alter all existing arrangements, not prejudicing the legality of any holding, or terms of tenure, between landlords and tenants—whether leasehold or otherwise, as may be necessary to estab-

lish a permanently uniform and continuous water accommodation to every building of whatever denomination ; and with respect to all future buildings, of any and every description, the parties so building should be supposed, expected, and compelled to have possessed with the site upon which such building is intended to be erected, a supply of water ; such provision of water to be made by the Commission herein provided, and the expense of such provision to be paid for as part and parcel of such site. Or if such site be leased for building purposes, the ground landlord should be compelled to pay for the provision of a water supply, and to make terms with the lessee accordingly ; and the water rate should be made in accordance with the fixed assessment on the property, and in all cases to be levied and made compulsorily payable *pro rata* for time of occupation only.

3. The measure should afford powers to the Commission to raise from time to time, upon the security of the rates, any sum or sums of money for the purpose of providing, increasing, and improving the general water supply to the metropolis and its suburban districts ; to purchase the plants of existing companies, and to apply the same to sanitary purposes or otherwise ; to institute inquiries as to whence water may be obtained in abundance and purity ; and to establish an entire new service throughout the metropolis for domestic purposes.

4. The measure should afford powers to institute a board of arbitration between the commission therein provided and the existing water companies, for compulsorily effecting an equitable adjustment of all existing vested interests in the present water supply ; for fixing and awarding such a compensation as may, upon due investigation of such interests, appear just and fair ; and for fixing and awarding a fair and just price for the present working plants of the companies ; and for arranging the payment of the amount of such compensation and purchase as may be agreed upon, either in money, at a specified time, terminable annuities, or in debentures of the commission bearing

four per cent. interest, to be periodically reduced in amount and ultimately paid off.

The above are the main features of my propositions in reference to providing administrative powers over the future water supply of the metropolis. Of course further working details would necessarily have to be provided for in the measure, but these I need not here enter into.

It may here be asked, why should the present companies receive any compensation for vested interests after having so abused the powers the legislature so unwittingly granted to them? I will merely answer that the public must be just if the companies have been unjust. Many of the present proprietors have taken little, perhaps no share, in those abuses; indeed many may be even altogether ignorant of them. The system which we have so much just cause to complain of, and which the intelligence of the age will no longer tolerate, took root with those against whom declamation and confiscation will now avail nothing. There may certainly be many who have taken a lion's share in, and are still desirous to perpetuate, the present monopoly, and undoubtedly would do so if they could; but a line cannot be drawn between those individuals and persons who may recently have invested, at the market premium price of shares, a whole life's earning in the present water supply, upon the faith of existing acts of parliament, and in the honest belief that in providing for a first indispensable necessity in the social requirements of the public, a good object is supported and a safe investment secured; and thus, under such circumstances, many widows and orphans may be, and undoubtedly are, left solely dependent upon such investments for their support. And as the abuses complained of have in part arisen through bad legislation, and it being publicly essential and imperative to alter the existing system, it would, in my opinion, be both impolitic and unjust not to take such vested rights into fair consideration.

As your columns will, without doubt, be spared to my communication with great difficulty, I will here close this letter,

and ask for space at an early date to conclude my observations upon the fiscal part of the question, and also as to the various sources whence an improved supply of water may be obtained.

I have the honour to be,

SIR,

Your most obedient Servant,

JOHN LOUDE TABBERNER

London, March 6, 1850.

WATER SUPPLY OF THE METROPOLIS.

TO THE EDITOR OF THE "DAILY NEWS."

SIR,

In my letter of the 6th inst. I feebly attempted, and I hope not in vain, to prove that water is not a commercial commodity, and that, as public property, it should be administered by a commission, directly responsible to the inhabitants and to government supervision—such as I therein presumed to suggest, or one similarly constituted. In continuation, I will now venture to attempt a concise exposition of the present cost to the inhabitants of the metropolis for the partial and impure water supply as now afforded by the existing companies. I will endeavour fairly to state the circumstances which encompass the question in reference to a valuation of the present working plants, and the relative proportion such valuation bears to the gross stated capital of all the companies. To meet the difficulties of the whole case, and to attain as close an approximation to the amount, it would be fair and just, as between the companies and the public, to pay the former for a transfer of all

their working interests to the latter, as the statistical data I possess will enable me. I will also endeavour to elucidate the extreme outlay it will be necessary to provide for effectively improving the quality and rendering a continuous and an abundant water service to every house throughout the metropolis and its suburban districts; and to exemplify the beneficial results which will ultimately accrue to the public in a fiscal point of view, by now adopting an enlightened, liberal, and comprehensive course of action, even such as I humbly submit for adoption; which, under the provisions of a judicious act of parliament, will not necessitate the aid of one shilling from either the government or a rate-payer.

To truthfully approach the present cost of water to those inhabitants now supplied, and the monied position of eight of the present metropolitan companies, it will be necessary to go back to the returns made by each to a parliamentary committee in the year 1834, such returns showing—

1st. That in 1833 their respective capitals had been from time to time augmented to the amount and in the manner here stated.

COMPANIES.	Amount of cash capital absolutely subscribed by the shareholders.			Amount of capital acquired from rates levied on the public.			Total accrued capital, representing the works worn out and at present in operation, and upon which dividends are now paid from rates levied upon the public.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
New River*	500,000	0	0	616,964	0	0	1,106,964	0	0
Chelsea Water ..	70,000	0	0	201,311	0	0	271,311	0	0
West Middlesex	378,466	6	9	189,579	3	3	568,045	10	0
Grand Junction.	206,000	0	0	125,174	1	7	331,174	1	0
East London ..	436,139	0	0	158,849	0	0	594,988	0	0
South London ..	98,000	0	0	147,306	13	10	245,306	13	10
South Lambeth..	35,920	0	0	146,633	0	0	182,553	0	0
Southwark†	25,000	0	0	.....			25,000	0	0
	£1,749,525	6	9	£1,585,816	18	8	£3,335,342	5	5

* The amount here stated, as paid in cash, is presumed—the company refusing to dissect their capital—to respectively show the amount absolutely subscribed, and the amount acquired from rates.

† The company did not dissect their capital, and the amount being comparatively small, I have stated it as all paid by the shareholders.

2nd. That their respective gross incomes and gross items of expenditure were then as follows:—

	Gross Income from Rates levied upon the public.			Gross Expenditure on their works out of their gross in- come.		
	£.	s.	d.	£.	s.	d.
New River Company.....	98,307	0	0	38,000	0	0
Chelsea Company	22,906	0	0	13,481	0	0
West Middlesex Company	45,500	0	0	18,000	0	0
Grand Junction Company	26,154	9	0	11,000	0	0
East London Company	53,061	10	0	15,080	0	0
South London Company	9,000	0	0	4,000	0	0
South Lambeth Company.....	14,808	0	0	6,500	0	0
Southwark Water Company	7,850	0	0	presumed 3,000	0	0
	<u>£277,586 19 0</u>			<u>£109,061 0 0</u>		

Showing a net income of £.168,525 19s., or more than five per cent. on their gross total capital, or a little under 10 per cent. on the gross actual subscribed capital, leaving the gross acquired capital from the rates made on the public as a bonus to the shareholders on the joint undertakings.

3rd. That the number of houses they then respectively supplied, and the average rates they then respectively levied upon each house were as follows:—

	Number of houses supplied.			Average rate le- vied on each house by each company.		
				£.	s.	d.
New River Company	70,145	.....		1	6	6
Chelsea Company	13,892	.....		1	13	3
West Middlesex	16,000	.....		2	16	10
Grand Junction Company	8,780	.....		2	8	6
East London Company	46,421	.....		1	2	9
South London Company	12,046	.....		0	15	0
South Lambeth Company	16,682	.....		0	17	0
Southwark Company	7,100	.....		1	1	3
	<u>191,066</u>			<u>8) 12 1 1</u>		

Showing an average rate upon each house supplied of.....£.1 10 1½

Since 1833 there has been no manifest outlay on the part of the companies in improving or enlarging their sources of

supply, but we have it admitted by Sir William Clay that the present supply of water from the above eight companies is 44 million gallons per diem, the distribution and public cost of which is made amongst, and levied upon, 259,668 tenants; so that some outlay, it may be fairly presumed, has been incurred in extending pipes, and increasing engine power, but not necessarily to an extent which the increased number of tenants may, at first glance, indicate; for it is possible, indeed certain, that many of their new tenants have been taken on to the service within the range of their plants as constructed in 1833. But to give the present companies the benefit of every doubt, I will presume they have afforded an entire new plant for the accommodation of their new customers, the increased number of whom is 68,602, occupying as many houses, containing an aggregate population, allowing seven persons to a house, of 480,214; and estimating the very outside cost of such an extension of their works, conjointly at £.1* per head of the population so additionally provided for, the joint capitals of the above eight companies would be increased accordingly. Presuming, therefore, that the average rate now charged by the companies conjointly is not less, and it certainly ought not to be more, than they charged in 1833, *viz.*, £.1 10s. 1½*d.*, the present gross income of all the companies would be, on 259,668 houses, at that average rate, £.391,124 18s. 6*d.*; and supposing the amount of their annual working expenses to have increased at the rate of five per cent., and surely that will be low enough to satisfy the companies in making a presumed estimate for the ultimate purchase of their present annual income upon their increase of capital of £.480,214, their present working expenses will have increased between 1833 and 1849, from £.109,061 to £.133,071 14s., deducting which latter amount from their present gross income of £.391,124 18s. 6*d.*, it will appear that their present net income is £.258,053 4s. 6*d.*, or a little under seven per cent. on their gross

* In estimating the cost of a water supply to large towns, £.1 per head of the population is supposed to give the required capital for the construction of all necessary works.

capital of £.3,815,556 5s. 5d., or a little under 12 per cent. on their actual subscribed capital of £.2,229,739 9s. 6d., presuming in the latter sum that the supposed additional outlay of £.480,214 for the accommodation of their increased tenancy since 1833, was subscribed by the shareholders in cash, leaving as I have before pointed out, the acquired amount of capital from rates, *viz.*, £.1,585,816 18s. 8d. as a virtual, indeed, a positive and absolute bonus to the joint shareholders of all the eight companies. To purchase this position, or to take this annual income of £.258,053 4s. 6d. out of the hands of the present companies, equitably, and to do equal justice to both the public and the shareholders, is the difficulty to be surmounted in changing the power of control over the future water supply of the metropolis: in making such supply a public, instead of a commercial property. Here, therefore, it is necessary to analyse the stated capital of the companies, and all the circumstances pertaining to its creation and continuous increase, till it has arrived to its present amount. And here it must also be borne in mind that the above estimated gross capital virtually represents and includes every shilling that has ever been laid out in the water supply of London and its suburban districts since the year 1580; for the New River Company, and the East London Company, after over-running all old interests, and thereby reducing them to a mere nominal value, bought such interests, and directly or indirectly capitalised their outlay in making such purchases.

I will, therefore, first endeavour to presume or to compute the amount of that portion of the gross capital which represents works worn out and superseded. To approximate this difficult result, I believe there is but one course to take, *viz.*, to ascertain the cost of an entire new plant over the same ground (and this is giving every benefit of the change to the shareholders) as the companies now occupy: and I think it is scientifically admitted on all hands, that a new service extended to every tenement throughout the metropolis, on the most approved hydraulic engineering principles, would not much exceed £.2,000,000. I therefore presume no one can grumble

if we take that amount as the value of the absolute working plants of the companies—(most certainly the companies cannot grumble)—and the difference between that sum and the gross capital of £3,815,556 5s. 5d., viz., £1,815,556 5s. 5d., as the representative cost of works long since worn out and replaced by the existing working plants. This, I contend, is a fair way of putting the question of valuation in a commercial form on behalf of the public as against the companies—indeed as between both parties. I shall, therefore, fairly presume that the capital at this present time absolutely employed by the present companies, for the use and accommodation of the public, is £2,000,000, upon which they receive a net annual income of £258,053 4s. 6d., or more than a 25 per cent. dividend. In purchasing this very strikingly lucrative property we have to take into consideration the dead weight upon it of £1,815,556 5s. 5d., which is represented in the premiums on the shares of the company (for in no other way can it be represented), which premiums are kept up in amount and value by the immense annual income derived upon the absolute and comparatively small amount of capital or value of plant, compared with the gross amount of capital now at work for the accommodation of the community. Nor must it be forgotten that £1,585,816 18s. 8d. (as shown in the returns of the companies made to the parliamentary committee of 1833), of the gross capital of which the dead weight of £1,815,556 5s. 5d. forms a portion, has absolutely been derived from rates levied upon the public—the party I propose should purchase; and not from subscriptions of the shareholders of the companies—the party I propose should sell; upon the face of which it is plainly, indeed forcibly, manifest, that if a very handsome return for legitimate capital, and an ample provisional annual rest for keeping good the working plants, had at all times only been exacted of the public, the rates could not, nor would ever, have been more than one half the average amount as at this present charged by the companies. With this part of the question, however, it must be considered that some at least, perhaps many, of the present shareholders have

morally nothing whatever to do: they purchased their shares at the market premium price; and, although an income of more than 25 per cent. is being derived from the public on the capital absolutely employed, yet not more than 5 or 7 per cent. (as the case may be) is paid on the absolute amount they have invested in the purchase of shares. This must be admitted; and now comes the test of the permanent market value, as between the public and the shareholders, of the present net income of the companies. The present shareholders say they have invested their money upon the faith of the existing acts of parliament, and it is presumed and expected by them, (and I believe by many in the honest conviction that parliament is bound to justify their confidence in such acts of parliaments, under the impression that the present exclusive position of the companies is therein provided for,) that by those acts their vested rights in the water supply of the metropolis will be respected and protected. I allow, under existing circumstances, that it will be right to respect them as far as the purchase of the present working plants by the public extends; but how far the shareholders must look to their acts of parliament to protect their income, as now derived from the public, from depreciation will now clearly and distinctly appear. It must be stated on the part of the public, that in no single instance has any one of the many acts of parliament, from time to time granted to the respective companies, provided that an exclusive district of the metropolis should be entirely and for ever devoted to the absolute benefit and emolument of each company. On the contrary, it was fully expected by the legislature that the principle of "competition by private enterprise," upon which I animadverted in my former letter, would protect the inhabitants from imposition on the part of the companies; and I will do the companies the justice to say, that when they obtained their original acts of parliament, I do not think they ever for one moment contemplated dividing the metropolis into exclusive districts, or of imposing upon the public the oppression of a monopoly which, for the last thirty years, has virtually been a continuous and flagrant violation of the acts of parliament

they so obtained. The commercial competition which the legislature, in its inexperience, presumed a water supply would bear, the companies practically discovered would ruin them, if they kept faith with the legislative spirit which had dictated the granting of their several acts; so, in self-protection, they entered into a mutual, and amongst themselves, legally binding arrangement, with which, it must be constantly and unequivocally borne in mind, the legislature had nothing to do, to divide the metropolis into several distinct territories, apportioning one to each under stringent covenants and penalties not to interfere with each other; so that within its own respective and exclusive district each company might charge whatever amount of rates upon the public the shareholders chose in satisfaction of their own selfish purposes, and supply any given quantity of water, more or less, as it was convenient, and of any quality, however impure, without any fear that the inhabitants would obtain relief from this unprecedented and intolerable combination by seeking another source of supply*. The legislature never could have contemplated, or even thought it possible, such an arrangement as this would ever be entered into, to the literal destruction of the social freedom of the inhabitants, or even the shadow of such an abominable coalition would have been carefully provided against; and the public would have been protected from the indiscretions and inconvenient rivalry of the companies at one time, and their oppressive usurious and uncontrollable exactions at another.

Here, then, is the point at which it must be decided, as to how the present monied position of each company has been acquired; how the vested interest of each have been established, and how secured. They cannot claim a prescriptive position. They can only contend for a commercial standing, subject to the same influence of competition as they themselves waged against each other from 1810 to 1820. Their vested interests in the water supply of the metropolis have un-

* The power and vested influence of the existing companies was such as to buy up any new project, or to prevent any *new* company getting a bill through parliament.

doubtedly been established in their own exclusive arrangements ; and upon the intrinsic worth of the covenants of their own contract with each other the premium value of their shares must increase or diminish. So far then they evidently cannot look to either the public or parliament for any protection or consideration as a right, in reference to the premium value of their property.

I know it may be assumed, and it may be meet for the companies to expect, that competition, under restricted regulations might, under existing circumstances, be submitted to by the public ; or the present companies may say, let us continue to supply the metropolis with water under such a supervision on behalf of the public as shall for the future insure to every house an abundance of pure water on such an improved system of service as the adaptability of our plants will allow, and at a cost to the inhabitants as shall not exceed a fair ordinary interest on our present gross and any required increased capital. Such an arrangement as the latter, they may say, will settle the question at once without the necessity of raising money on the future rates to pay us off, or constructing a new plant. They may say we will bind ourselves to afford a supply to every house, and as pure and wholesome as it can be obtained under any new administrative powers of control ; by continuing us as servants of the public, you will not interfere with rights which of necessity were founded through the ignorant legislation of the past, and have grown up to a property which ought at least to be dealt with with some sympathy. Our property, they may further say, has been invested for the social good of the community, and although one portion of our capital which has from time to time been employed, was obtained by rates out of the public purse, and although another great portion of the whole, now charged upon the public, represents works not now in existence, and, consequently, of no value, use, or benefit to the present generation, yet we (the present proprietors) have either purchased our shares at their present value, or we have had them left to us as property of such a given value ; and why should that value be depreciated while we are

so willing as we now profess to be—to which professions we will bind ourselves—to place the future supply of water on such a footing, and under such legal supervisory arrangements, as shall preclude the possibility of a recurrence of any abuse whatever, either in the system of rating, management, or mode of service? To all this I say, that a grave legislative error has been, unfortunately for the public weal, once committed. In the first instance the legislature most wrongly conceded a power which must be legislatively rescinded. The returns of the mortal scourge which lately visited this most wretchedly conditioned city impressed upon the public mind, with unmistakeable woe, the value of a good and wholesome water supply in preserving life and health. In the truth that between 70,000 and 80,000 houses, containing a population of between 600,000 and 700,000 inhabitants physically emaciated and morally prostrated, through being denied a first natural necessity and public right, exists a serious, a fearful responsibility; which those whose imperative duty it is to remove are sacredly bound so to act, as to effectually wipe out this plague spot from the annals of the poor, and to provide such a measure as will for ever preclude its resuscitation. With respect to the depreciation of the premium value of the companies property—such a property as it really is—such premium value is clearly open to the influence of daily changes, and can only be estimated as the circumstances upon which it is based will permit; and those circumstances are such as can hardly claim consideration in any way, either from the public or the legislature, if the question of value was to be dealt with upon its public merits. It may, however, be politic on public grounds, *i. e.*, to facilitate the attainment of a great public good—to afford the relative positions of the public and the companies to be considered on a par, and on one hand concede to an extent the imperious claims of a public right to effectually and for ever destroy a public wrong; and, on the other hand, to make allowance for the supposed misplaced confidence of some of the present shareholders of the companies, in an investment which has grown commercially valuable on that

public wrong ;—I will so consider and so value the companies' present annual income. And, as regards their continuing to hold the administration of the metropolitan water supply, I contend that no future time can possibly afford a more favourable opportunity than the present for the government to resume that power, which it so erroneously applied in placing the water supply in the hands of trading bodies in the first instance. Under this impression, I believe in the imperative transfer of the present working plants from the companies to a public commission; and will test the value of such plants upon commercial grounds on one side, and public convenience on the other,—absenting from my mind for the moment the question of water being a public property, and the very long and serious public wrongs inflicted, the social rights infringed, the physical comforts compromised, the moral laws broken, and the amount of life and health destroyed through its having been subjected to commercial gains and a capricious power of control. The want of legislative foresight on behalf of the public on one hand, and the legislatively unprotected exclusive arrangements which the companies entered into amongst themselves on the other, is clearly manifest. The aggrieved party—the public—have, however, a remedy left open; they have a just claim on the legislature to redress their grievances—even if no other course was open—by granting such fresh powers to new water companies as would insure competition. The question is, therefore, now open for the public to say whether they will again have the water supply subjected to the influence of “competition by private enterprise,” or “municipal regulations.” Past experience unquestionably dictates the latter course, but at the same time the present companies cannot deny the right of the public to the former; and in purchasing their plants the public are justified in asking the companies what their plants would be worth in ten years time, provided new companies were introduced and new supplies of water so afforded? And experience from 1810 to 1820 answers the question. They would be worth little or nothing! This competition, however, would inconvenience the public by continually breaking up the streets, impeding

business, and occasioning a public annoyance. And in the end it would bring all the companies to a similar necessity as 1820 witnessed—but with this difference to the companies, that such an exclusive and obnoxious arrangement as they then entered into, would not be left open for adoption again in the granting of any new acts of parliament. So in whatever way the question is settled, all monopoly is gone, and not more than a legitimate profit upon capital invested could be gleaned in future. I therefore submit that, under all circumstances, it will be wise, independent of the undoubted right and power of the public to have the water supply restored to municipal control, to meet the companies fairly, and give them—and not bad policy on the part of the companies to accept from the public—ten years' purchase of their present net revenue for the transfer of all, and only their working plants—leaving their retired or rested property, which has accrued from their gains on water, and which is known to be very considerable, especially that of the New River Company, entirely out of the transaction, to their own benefit. Their present net income therefore being £.258,053 4s. 6d., which sum being multiplied by 10 (ten years' purchase), the amount of purchase money would be £.2,580,532 5s*.

This presumptive value of the present actual working plants of the companies as created by the purchase of revenue, would exceed the presumed absolute value of an entire new plant by £.580,532 5s. I therefore think such an offer, if made, could not be considered otherwise, under all the circumstances connected with the general question, than including a fair respect for the vested rights of all the present shareholders.

I have now to consider the purchase of the respective plants of the Hampstead and Kent Water Companies—the fact of these two companies not having hitherto been included in the accepted category of metropolitan companies, no public returns have been officially made by them upon which any estimates could be presumed with any approximate pretensions to a valuation of their

* In my former publications I have estimated the amount of purchase money on a presumed revenue, based on the net income of the companies of 1833, without any subsequent data to guide my calculations.

interests. I would therefore include the purchase of these two plants, with the contingencies incident to the general transfer of the whole of the present metropolitan water service to the administrative powers of a public commission, and in perfecting such present service to permanent sanitary uses; for which contingencies I will allow the difference between the presumed amount of the purchase money I have proposed should be paid to the eight companies and £3,000,000. To this sum I will add £2,000,000 as the cost of a new continuous service to every house for domestic purposes, making together a total of £5,000,000* as the extreme necessary outlay for establishing the future water supply, as a public institution, on such a scale as would amply meet all the social requirements of the present and future ages.

I would here add my humble opinion, that to attain an efficient continuous service a uniform force and motion must, as if taken from one store reservoir, be accomplished, although the supply may be taken from several sources. I do not say that the existing plants could not be made available to a continuous system, but I will venture to say that they would require infinite alterations, at an immense cost, to make them answer the exigencies of such a mode of service.

I will now, in conclusion of this letter, briefly show how I would raise the required sum of £5,000,000 for the uses of the proposed public commission, how I would repay the same and discharge the current working expences of an efficient water service, and afford, at the expiration of a less period than 30 years, under good management, the whole of the metropolitan water supply at the bare cost of conveyance, and withal, not require so large an average rate from the public—*viz.*, £1 10s. 1½*d.*—as is now levied by the present companies.

The present population of London and its suburban districts is 2,336,000. The mean number of persons to every house on the south side of London (according to the registrar-general's report) is six, and the average rental of the house is £.25; and on the north side 8, and the average rental of the house is £.46.

* My former estimates of the total capital required have been based on the purchase of the plants of eight companies only.

I will, therefore (though it is, in fact, rather more), take the mean number of persons to every house throughout the metropolis at 7, and by dividing the number of inhabitants by the same, the number of houses comprising the metropolis will appear as 333,714, say in round numbers 330,000.

An average rate of £.1 7s. 6d. (2s. 7½d. less than the average rate now levied by the companies on their tenants) levied on 330,000* houses would produce an annual revenue of £.453,750, which sum would enable the proposed public commission for improving and administering the future water supply of the metropolis,

1st.—To raise £.5,000,000, upon its debentures, at four per cent. £.200,000
(or to establish terminable annuities on the same basis).

2nd.—To pay the current working expenses of the water supply to 330,000 houses, affording to each house 175 gallons, or to each individual, of a population of 2,336,000, 25 gallons daily, at an average annual cost of 8s. per house. Estimating the cost of water so delivered, to each dwelling, in accordance with the estimated prime cost of the water supply of the present companies, and also of the proposed supplies of the new schemes now under public notice, at 1½d. per 1,000 gallons, say 133,000

And 3rdly, in addition to the above, afford an annual rest to the gradual liquidation of the principal debt of £.5,000,000, of 120,750

£.453,750

In computing the number of houses as comprising the metropolis at 330,000† by dividing the present amount of population

* Taking the number of houses as here stated as comprising the metropolis, and the average rent of each house to be £.35 10s., the annual rental of the whole would be £.11,715,000. And taking the annual revenue of the water rate at what I have stated, viz., £.457,750, it will appear that the cost of a water supply under the regulations I have suggested would at first be as near as possible 3¼ per cent. on the gross house rental of tenants supplied.

† By deducting from this number 259,668 (the number of tenements now

by the mean of seven persons to a house, I know I have made an extreme number of tenants; but in estimating the future annual revenue of a universal water supply by an average rate of 27s. 6d. on that number, I wish it understood that even a greater number of tenants than I have estimated the revenue upon would be subject to the rate by including all manufactories and public places.

This annual liquidation of the principal debt would annually reduce the average rate of 27s. 6d. in proportion to the amount of its product set aside for the reduction of such debt, and the fiscal burdens on the water supply would thus gradually diminish, till the whole debt was progressively paid off, and the inhabitants left in free possession of a natural and public right.

I fear, Sir, I have been betrayed into too great a length; should you, however, deem my remarks on this important subject worthy of further insertion, I shall have pleasure in having afforded them, and will, in another communication, beg to make some observations on the sources available as a new water supply to London, and also on the water bearing stratum of chalks beneath and around the metropolis, and on the different qualities of the water contained therein at different places.

I have the honour to remain, Sir,

Your obedient Servant,

JOHN LOUDE TABBERNER.

London, March, 9, 1850.

supplied with water, as per Sir William Clay's statement) it will appear, even if these supplied tenements were all dwelling-houses, *which is not the case*, that 70,332 houses are at this present unsupplied with water. And as the houses so unsupplied are of the very worst description, and crowded with the poorest and most wretched of our species, it is not improbable, indeed quite certain, that the average number of individuals dwelling in each house will exceed ten. If, therefore, we multiply the number of unsupplied houses—*viz* : 70,332 by 10, we have more than 700,000 of our metropolitan population without that first indispeusable article of subsistence—water; to obtain any given quantum of which they are compelled to beg or steal, or barter their existence and stunted earnings away under every social disadvantage, to secure from the demoralising stand-pipe, the publican, the huckster, or the baker a miserable, and it may be said an unsupporting water accommodation.

WATER SUPPLY TO THE METROPOLIS.

TO THE EDITOR OF THE "DAILY NEWS."

SIR,

Having in my former letters endeavoured incontestably to prove that the administration of our present metropolitan water supply is wrong in principle, and, to the common community, bad in effect; at the same time offering suggestions as to a future titular control and administrative management, accompanied with a presumed practical exemplification of the publicly beneficial results to be derived under the latter, I will now observe on the quantity of water at present afforded; and also upon that which is additionally, and how available, within a given distance of, and under London; and conclude by explaining why the constituents of the water now, and of that which may be supplied are different at different places.

The quantity as at present supplied from every source cannot be correctly arrived at with any degree of certainty. A presumed approximation to the absolute quantity can only be a supposition. I will, therefore, first avail myself of Sir William Clay's statement, that the eight principal water companies supply 44 million gallons daily, and presume the respective quantities supplied by the Hampstead and Kent companies, by the deep borings into the chalk formation, and by land-spring pumps. I will apportion a given quantity as the supply of each company; but in doing so, it must be understood that I have only the district of each to guide me in allotting a relative supply of the whole 44 million gallons from each. The annual money disbursements of each company will not afford a correct data by which such relative quantities may be computed, as it is impos-

sible to say how such disbursements have been actually applied, nor have I any other data which will answer an undoubted inference. I will, therefore, suppose the following quantities to be at present derived from the following sources:—

	Gallons daily.
New River Company.....	20,000,000
Chelsea Company	3,250,000
West Middlesex Company	3,750,000
Grand Junction Company.....	4,000,000
East London Company	7,500,000
South Lambeth Company	2,500,000
South London Company and Southwark Company	3,000,000
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	44,000,000
Hampstead Company	400,000
Kent Company	1,250,000
Deep wells, called Artesian wells, sunk into the chalk formation	10,000,000
Land-spring pumps	3,000,000
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	58,650,000
To which I will add catched rain water	1,350,000
	<hr/>
Making a total quantity of water afforded for all purposes of	60,000,000
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This quantity distributed equally to 2,336,000 inhabitants would afford about $25\frac{1}{2}$ gallons to each daily. Such a supply, if pure, appears a self-evident good one; but what are the facts pertaining to such a supply in detail? First, at least one-third of the whole must be deducted as running to waste, under the intermittent principle of supply, leaving 40 millions of gallons only for absolute use; from which must be deducted a supply for the following requirements:—

For horses and cattle of all kinds in numbers proportionate to the living wants, artificial necessities, and working powers of this great community.

For slaughtering purposes of every description ; for distilleries, breweries, dyers, manufactories, hospitals, prisons, barracks, public places, water-closets, watering streets, and fires, &c., which will undoubtedly take one-half the 40 million gallons, leaving for domestic purposes but 20 million gallons daily, for a population of 2,336,000, about $60\frac{1}{2}$ gallons to each of 330,000 houses, or an average of about $8\frac{1}{2}$ gallons to each individual for washing, cleansing, culinary, drinking, and ablutionary purposes ; and the whole of a quality, with the exception of a fractional portion, utterly unfit for human purposes, especially the supply on the south side of London.

From these figures the domestic condition of the lower classes may be easily supposed. When the wealthier classes have taken their required portion out of the above stinted whole, the average quantity left for the necessities of the poor will indeed be a couzenaged share ; and I do not think I have unfairly conjectured the existing truth. Yet this miserable, this perishing supply, as a whole, costs the inhabitants indirectly,—for we must include the necessary receiving cisterns, butts, &c.—*half a million of money annually*, independent of the cost of cesspools, which, under an efficient system of water supply and drainage, might be entirely dispensed with.

I will now, in the hope of aiding in the attainment of a better, more abundant, and cheaper supply of water to the metropolis, beg to repeat that no apprehension need be entertained in respect to an ample additional supply not being available. I have no hesitation in saying that, if our daily necessities were such as to imperiously require a further supply of 200,000,000 gallons, that quantity of surface water alone, suitable for domestic purposes, might, with ordinary engineering exertions, be immediately conveyed to the inhabitants from sources within a thirty-five mile radii of London.

The average annual depth of rain which falls in the vicinity of the metropolis is 21 inches ; and, if we allow even one-half to be taken up by evaporation, though but a third of the whole is

the proportion supposed to be so taken up and absorbed in the sustenance of the vegetable kingdom, we have $10\frac{1}{2}$ inches percolating into the earth, and by its own gravity finding vent in the surface channels thereof; and if, by contouring the surrounding country, and taking the vales of the surface, large bodies of water might be collected and stored in various parts from the innumerable land springs which, in those natural catchments, flow as the concentrated drainage of the surrounding surface elevations. The water so collected would vary in quality according to the chemical properties of the different strata it percolated through, but generally speaking it would be good for household purposes, more especially in the south-western districts, where a gravel stratum extends over a vast area. In cases of long drought, however, a permanency of supply from such sources would naturally fail, unless store or artificial catchments were constructed sufficiently large to make a provision in times of heavy falls of rain, against such certain casualties; and I only allude to such sources of supply as introductory remarks to the larger supplies more directly available and more strikingly afforded from the chalk structure around London. The many adjacent surface rivers all take their rise from the springs of the upper portions of the chalk formation, which extends under London beneath the alluvial deposits, and crops out to a greater or lesser extent around us, forming what is commonly called the London basin, the whole area of which is nearly 4000 square miles—*i. e.*, that portion of the chalk structure which may properly be termed the London basin, of which area, as nearly as possible, 1200 square miles crops out and forms the elevations of Hertfordshire, Hampshire, Surrey, and adjoining counties. By taking the whole of the exposed surface of the chalks in Cambridgeshire, Norfolk, &c., there is an exposed area of the formation of about 4000 square miles, but that portion of the chalk surface which may be correctly taken as forming the London basin—*i. e.*, that portion of the formation which forms a catchment available to

the metropolis—must be computed from a circle of altitudes forming the highest points of the chalk structure, the surface within which is the area of the London basin, and the exposed surface of the chalk within such given area is, as I have before said, about 1200 square miles. A portion of this latter area is what is geologically called the block or back chalk, and is impervious; consequently, the rain which falls upon it flows over its surface on to the stratified portion of the chalk surface, into and down the fissures of which, with the exception, of course, of what is evaporated, it percolates into the depths of the formation. It is from the springs in the declivities, or surface vales of the chalk, within the altitudes above-mentioned, that the Kennet, Loddon, Aunborne, Brent, Colne, Verulam, &c., &c., Wey, Mole, Wandle, Ravensborne, &c., Rodding, Lea, Stort, Ware, &c., in all about twenty rivers, take their rise and flow in a metropolitan direction, receiving in their course the natural surface drainage of the land strata, and forming tributaries to the river Thames,—the trunk, or general catchment of the surrounding country,—through which it winds its serpentine course. From several of these rivers the water supply of London may be improved. Several schemes propose new and independent supplies from different parts of the trunk river; another from one of its tributaries, the river Wandle; others to improve the supplies of existing companies from the Ware, Stort, and Rodding. Another scheme proposes to sink shafts into a declivity of the chalk formation at Bushey Mead, in the Vale of the Colne, where it is proposed to raise sufficient water to supply some of the northern districts of London. Another similar scheme has been suggested to supply the south side of London from shafts sunk into the chalk formation on the line of the South Eastern Railway. I will just add that there are numerous plentiful springs of beautiful water in the vales or declivities within the surface area of the London basin, gushing forth and lost in the natural channels around, which might, by a careful contour, be diverted into available sources of supply.

In reference to the gross quantity thus derivable from the various sources here alluded to, it is supposed that from

	Gallons daily.
The river Thames above tidal influence might be taken	100,000,000
From the river Wandle	27,000,000
From the river Verulam and adjacent waters....	15,000,000
From the chalk springs at Bushey Mead	8,000,000
From the rivers Ware, Stort, Rodding, and the shafts sunk into the chalk formation, additional supplies might be added to the existing services of the New River and East London Companies of	10,000,000
From the chalk stratum on the east and south of London, by sinking shafts, as at Bushey Mead.	10,000,000
From Rivers Cray, Ravensborne, and diverted springs	2,000,000
	<hr/>
	172,000,000
Surface catchments, say at least	28,000,000
	<hr/>
	200,000,000
	<hr/>

I must not be supposed as advocating the entire collection of all these waters. I merely show that, if necessitated, we might have them. In reference to an improved general water supply to the whole of the metropolis, supposing surface water to be solely sought, I will here observe that, whether such improved supply be obtained from one, two, three, or more sources, all should be conveyed to one grand water store at the highest point of Hampstead for a continuous service to all London: even the New River, if continued as a portion of the domestic supply, should also be diverted to the great store reservoir or reservoirs, for it would be necessary to have two at least. A similar arrangement should be effected on the Surrey side of London if necessary; but I am of opinion that from the Hampstead ele-

vation an abundant supply might be afforded both to the south and north of the metropolis; and in the construction of the new Westminster bridge an aqueduct or aqueducts, of ample dimensions to carry the supply for the south side over the Thames, might be made without damaging the architectural design of the bridge; or the supply for the south side might be carried over the Thames at the different levels of the several bridges by means of iron mains. The reservoirs at Hampstead should be divided into compartments to facilitate cleansing and keeping the water in motion, and thence a uniform hydrostatic force should be attained; thus a universal continuous supply of water to every room of every house throughout the metropolis and its suburban districts might be obtained, and fire brigades, &c., superseded. Such an undertaking would, I am aware, involve the necessity of considerable lifting power; but no waste whatever would ensue, and I believe the whole cost upon the required supply would not exceed $1\frac{1}{2}d.$ per thousand gallons, even if every drop was filtered.

I will now proceed to say what may be done in another form—I mean by sinking wells into the depths of the chalk formation beneath London, whence I persevere to contend that an inexhaustible supply of wholesome water may be obtained. Not that I expect effectually to impress such a conviction on the public mind, for between the self-interested views of some, the prejudices of others, and perhaps I may add the inexplicable doubts of most, this important available acquisition to the water supply of the metropolis is burdened with such a weight of mis-cordance, that I fear much time will be lost ere the invaluable truth will be allowed to develop itself.

To afford a comprehensive explanation of the action of hydrostatic laws within this immense water-bearing stratum, would occupy more space than you could possibly apportion to me. I will, however, attempt to make myself understood with as much conciseness and brevity as possible. Opinions upon this most interesting topic vary, and diverge to different theoretical results; and, I am sorry to say, the best of feeling has not been at all

times exhibited in the expressions of those who have been supposed to be the most intelligent on the subject, when their views have been opposed and practically refuted. I shall not, however, digress to discuss the personal views of any individual, further than may be essential to illustrate my own. And should I use any untenable remarks, wrongly argue any portion of the question, or use any assertion unsupported by practical facts, I shall feel happy to be corrected, for it is truth alone I am desirous to develop to the public.

There are those who *superficially* denounce the possibility of obtaining water *subterraneously* for the use of the inhabitants of London, as a wild and visionary hope—there are those who, upon the *mere faith* of such denunciation alone, proclaim the impossibility of such an accomplishment—there are others who say there is in *such an idea* “a degree of extravagance and “opposition to nature”—and others who declare that the water contained in the chalk is *all being pumped out of it*, and contend that that which remains is impregnated *with the present sea water*—and there is one gentleman who supports both the last theories, while he writes as follows, and affirms and contradicts a position in the same breath:—

“When many wells were sunk, and powerful steam engines “were erected to raise this water, as soon as more was lifted “than could be supplied through the small pores of the chalk “underlying the London clay, the level of the water was gradually reduced to its present depth of 47 feet below the sea; “and the same fissures which formerly served as a partial outlet “for the upland water became the means of admitting sea water “to replace that thus abstracted.”

Now, one moment's reflection will lay bare to the most ordinary mind the fact that, if by pumping out the water of the chalk formation its levels therein had been reduced to 47 feet below the sea, and that if the same fissures which formerly served as an outlet for the upper chalk water became receivers of the sea water into the chalk formation, it is quite certain that the sea water so admitted would *as constantly raise* the water

level in the chalk by constant repletion from the sea as the abstraction alluded to *would lower it!* Yet this gentleman and others, to whom I have made allusion, would have it at the same time believed that *the depression of the water level in the chalk continues.*

I would satisfy myself by saying to all this, that I am bound to entertain such deseants as mere assertions only, unsupported by any really logical or practical deductions, but which, however, I will in the course of my letter logically refute.

I have before described the surface area of the London basin, within which all the surface rivers rise, and directly flow towards the metropolis. The vale of the whole chalk structure is beneath London, and a considerable portion of the rain and snow waters which fall upon the exposed surface of the chalk within the inclinations of the basin naturally percolates into its depths, whence I contend that a supply of water may be obtained for all the requirements of a population many times larger than London now contains.

Formerly most of the deep wells of London were sunk only into the sand bed above the chalk, the water of which, in some instances, overflowed the surface; but the quantity of water contained in the sand being limited, receiving the greater, indeed, nearly the whole of its supply from the fissures of the chalk elevations beneath the alluvial deposits, as the abstraction thereof has from time to time increased, the wells have ceased to overflow; and the repletion being very limited from the upper chalk fissures, a permanent diminution of the supply from that source,—i. e., the sand bed,—as the number of wells sunk into it have increased, is but a natural result; but it is very different with the chalk stratum as regards quantity of supply, and means of repletion as abstraction increases. I at once admit the fact that the apparent level of the water in the chalk has lowered within the last 50 years, and it would be a contravention of common sense to reason otherwise; but the reason why the supposed level of the water has so materially lowered, I will with deference attempt to show.

The structural form of the chalk is undulated on its surface beneath the alluvial deposits, as the land surface. The chalk rises in one place to within 100 feet of the latter, in another place to within 200 feet, in another it is not reached till within 300 feet, and in another not till within 500 feet of the land surface, and so on. In fact it is hill and dale throughout under the alluvial deposits, as the land surface is hill and dale around us. Into these elevations of the chalk beneath London its fissures ascend, as they also descend into the depths of its formation, immediately beneath which is another bed of green sand which also crops out with the chalk around us, and its surface area is also open to receive the rain. Beneath this lower sand bed is another impervious formation called the weald clay, similar to the body of clay above the upper sand bed, which lower body of clay prevents the water percolating lower down into the bowels of the earth, as the plastic or London clay above prevents the water of the land or surface strata percolating into the sand and chalk formations between the two bodies of clay: thus the sand and chalk formations become independent water bearing strata, cropping out (with the exception of the sand bed above the chalk, the outcrop of which is very trivial) to the surface around London, there receiving the rains of heaven, which by its own gravity percolates into the fissures and depths of the chalk, and also into the depths of the lower sand bed. The hydrostatic pressure thus naturally brought to bear in the chalk forces the water into its varied fissures—the greater portion into the depths of its structure, and some into its elevations—from the latter of which they empty themselves into the upper sand bed from the declivities of such elevations. It is thus that the sand beds above the chalk, and that the upper portion of the chalk formation beneath the alluvial deposits, become partially charged with water.

Before any Artesian borings were made either into the sand or chalk formations both were full of water, and when first tapped—if I may use such a term—the water rose to the surface, but as the number of wells increased that overflow ceased; and as

the borings were extended deeper into the chalk, the hydrostatic pressure which forced the water into its elevations became reduced in power, and the quantity of water in the sand diminished; and as the wells into the chalk were deepened and increased in number, the partial quantity of water contained in the upper fissures descended, and thus the apparent great depression of the water in the chalk we have heard so much about has been occasioned. This depression is not to be estimated as of the great body of water contained in the chalk, but merely as the lowering of that portion of the water contained in the upper fissures, which were first and are now partially charged with water by its own natural force. This depression, however, varies as the average quantity of rain and snow falling upon the outcrop varies; and as the pressure, consequent upon the quantity of rain and snow so falling, which forces the water into the fissures of the chalk elevations varies, so will the quantity of water in those elevations, and in the sand bed above, vary, till the abstraction of the water from the depths of the chalk becomes so great altogether as to reduce the general body of water in the formation, and so reduce the pressure which now sustains it in the elevations.

I have by me diagrams showing these elevations of the chalk structure, which I purpose publishing, with a fuller explanation than I can possibly give through your valuable columns, as to the capabilities of this water-bearing stratum to yield an abundant and an inexhaustible supply of water to the metropolis—I affirm abundant and inexhaustible, for so long as the rain continues to fall repletion will always and for ever be afforded. And the green sand bed beneath the chalk will, upon the same principle, always be charged with water, and by boring through the chalk the water of the lower sand formation might also be obtained. There are, however, many circumstances in making artesian borings into the chalk for water, which tend to create doubts and difficulties. In many instances borings have been made into the elevations of the chalk, and, as will already have appeared to the mind from what I have said, not been successful in obtaining water. In other instances, water has been at first obtained, and then lost. The occur-

rence of all these casualties is certain, till the structural form of the chalk becomes better understood. An elevation of the chalk—a perfect ridge indeed—extends round from Millbank-street, Westminster, Seven Dials, St. George's, Clerkenwell, Brick-lane, Tower-hill, and the well of the Royal Mint penetrates its declivity. There are also other difficulties in boring at Brentford; it would appear that an elevation of the block or back chalk is met with there. Again at Hampstead, they have gone a great depth, and only obtained a partial supply of water; but although their depth is very great from the surface, yet they are not so deep into the chalk formation below Trinity datum as the well at Trafalgar-square; and if they continue to bore into the depths of the chalk they will undoubtedly obtain abundance of water. It is an accepted opinion that by sinking a shaft at Trafalgar-square, similar to the one they have sunk at Hampstead, a body of water sufficient for the supply of the city of Westminster might be obtained; and any one who is acquainted with the vale of the chalk formation, as there evidenced, would not doubt the practical value of such an opinion. With respect to the sand bed above the chalk yielding an abundant supply of water independent of the chalk, as is maintained it does by some, the facts may also be freely tested at the Trafalgar Square works: by there stopping the bore-pipe into the chalk and bringing the pumps to bear on the strata of the sand bed alone, the abstraction will dry the well;—unstop the bore-pipe into the chalk, and the water cannot, to any appreciable extent, be lowered.

It has been accepted as a truth, in prejudice to the certainty of obtaining water from the chalk, that Messrs. Barclay and Messrs. Calverts, the brewers, are compelled to work alternate days in consequence of their wells being subservient to the abstraction of each other. It is well known that all wells sunk only into the sand formation affect each other; indeed, from the pervious character of the formation, it would be impossible it should be otherwise; and when both these firms first sunk their wells into the sand bed only, they undoubtedly did affect each other, but since Messrs. Barclay subsequently extended

their bore pipe into the chalk formation, they have received an abundant supply of water, while Messrs. Calverts have not in the least affected them. It is true, however, that the well of Messrs. Barelay has for some time past somewhat diminished in its yield of water, but the cause has been lately discovered. When they first bored into the chalk to improve their supply of water, they continued to avail themselves of the water in the sand by perforating the pipe which passed through the same, to allow the water contained in the sand to pereolate through into the well ; the consequence was that the sand also pereolated through and preecipitated into the bore pipe of the chalk, and therein became consolidated to an extent of 73 feet, stopping the free emission of water from the fissures of the chalk. The bore pipe of the chalk has lately been cleaned out, and the level of the water in the well immediately rose.

Messrs. Calverts still pump from the sand bed only, and, consequently, are liable to difficulty and a deficiency of water.

As regards the construction of an Artesian plant throughout London, I know it has been asserted and held forth, that the expenses of the working powers of such a water service would be enormous. To those who are practically acquainted with this part of the question, it is unnecessary to say anything. And I shall merely add, that it would not cost more, if so much, as any other scheme propounded, in proportion to the extent and magnitude of the undertaking. A continuous high service supplied by an Artesian plant, would be most simple and most efficient.

I find, Sir, I must conclude, though I hoped to convey in this communication my remarks upon the properties of the chalk water at different parts of its formation, which remarks will tend to substantiate observations I have herein advanced as facts ; I must, therefore, beg permission to forward another letter for insertion in your columns.

And remain, SIR, your very obedient Servant,

JOHN LOUDE TABBERNER.

London, March 13, 1850.

WATER SUPPLY TO THE METROPOLIS.

TO THE EDITOR OF THE "DAILY NEWS."

SIR,

In continuation and in conclusion (for the present at least) of my correspondence on the all-important question of an improved metropolitan water service, I will explain why the water of the chalk formation differs in its constituents at different places, and at the same time testify that the water in the deep wells under London is not impregnated with sea water; and, in doing so, substantiate my former observations in reference to the chalk structure being a medium in which the rains of Heaven collect and form a continuous, inexhaustible, and wholesome source of water supply available to the uses of this great and populous city.

It is necessary, in the first instance, to give an analysis of the water of the chalk as obtained at different places; I will, therefore, make use of the water as raised from the respective wells at the government works, Trafalgar Square, at the Brewery of Messrs. Combe and Delafield, at the Royal Mint, and from the chalk formation at Bushy Mead, near Watford, to which I will add the analysis of the water of the river Thames, above and within the influence of the London sewerage, as containing chalk water.

Water from the chalk formation Bushy Mead, near Watford :

	Grains.		
Carbonate of lime . . .	19.54		
Sulphate of lime . . .	0.94		
	—		
	Hardening constituents .	20.48	Grains.
Chloride of sodium . . .	Common salt . . .	1.90	
Carbonate of iron . . .	. . . . .	1.32	
	—		
	Solid contents, per gal . .	23.70	

Water from the Trafalgar-square deep well:—

	Grains.		Grains.
Carbonate of lime . . .	3.255000		
Carbonate of magnesia . .	2.254000		
	<hr/>	Hardening constituents . .	5.509000
Chloride of sodium . . .		Common salt . . .	20.058500
Phosphate of lime . . .	0.034041		
Sulphate of potassa . . .	13.671000		
Sulphate of soda . . .	8.749300		
Phosphate of soda . . .	0.291000		
Carbonate of soda . . .	18.048800		
Silicic acid . . .	0.971000		
Apocrenic acid . . .	0.098700		
Crenic acid . . .	0.137200		
Extractive matter . . .	0.672000		
	<hr/>		42.673041
		Solid contents, per gal. . .	68,240541

Water from the deep well at Messrs. Combe and Delafield's
brewery:—

	Grains.		Grains.
Carbonate of lime . . .	6.18		
Carbonate of magnesia . .	1.08		
	<hr/>	Hardening constituents . .	7.26
Chloride of sodium . . .		Common salt . . .	12.74
Phosphate of lime . . .	0.19		
Perphosphate of iron . . .	0.24		
Sulphate of soda . . .	24.25		
Carbonate of soda . . .	11.68		
Silicic acid . . .	0.44		
	<hr/>		36.80
		Solid contents, per gal. . .	56.80

Water from the deep well at the Royal Mint:—

	Grains.		Grains.
Carbonate of lime. . . .	3.50		
Carbonate of magnesia . .	1.50		
	<hr/>	Hardening constituents . .	5.00
Chloride of sodium . . .		Common salt . . .	10.53
Sulphate of soda . . .	13.14		
Carbonate of soda . . .	8.63		
Silica	0.50		
Organic matter	} traces.		
Iron			
Phosphoric acid			
	<hr/>		22.27
		Solid contents, per gal. . .	37.80

Water from the river Thames above the influence of London sewerage:—

	Grains.		
Carbonate of lime . . .	12.75946		
Carbonate of magnesia . .	1.02711		
Sulphate of lime . . .	0.45073		
Chloride of calcium . . .	1.75021		
			Grains.
Sulphate of potash . . .	0.66794	Hardening constituents	15.98751
Sulphate of soda . . .	2.00011		
Silicic acid . . .	0.27314		
Phosphoric acid . . .			
Carbonate of oxide of iron	traces.		
Alumina . . .			
			2.94119
Soluble organic matter . .	2.28536		
Insoluble organic matter .	1.19483		
		Organic matter . . .	3.48019
		Solid contents, per gal.	22.40889

Water from the river Thames within the influence of London sewerage:

	Grains.		
Carbonate of lime . . .	8.1165		
Chloride of calcium . . .	6.1165		
			Grains.
Chloride of sodium . . .		Hardening constituents	15.0906
Sulphate of potash . . .	0.2695	Common salt . . .	2.3723
Sulphate of soda . . .	3.1052		
Chloride of magnesia . .	0.0798		
Silicic acid . . .	0.1239		
Phosphoric acid . . .			
Alumina . . .	traces.		
			3.5784
Soluble organic matter . .	2.3380		
Insoluble ditto . . .	4.6592		
		Organic matter . . .	6.9972
		Solid contents, per gal.	28.0385

With respect to the action of all the constituents I have noted as hardening the water, I am aware that doubts may be entertained as to the fact of their being hardening constituents. The conclusion that they are so, however, is the result of long and deep investigation by a very able practical chemist; and I have not ventured to put them forward as such without being fortified with the capability of substantiating such conclusion.

The constituents of the chalk water from the above four sources vary, it will be perceived, in quantity and number

most remarkably. The Watford water is nearly four times as hard as the water of the Trafalgar Square well; nearly three times as hard as the water of Messrs. Combe and Delafield's well, and four times as hard as the water of the Royal Mint well—the three latter containing counteracting (*i. e.* softening) constituents, while the Watford water contains none whatever.

The Watford water contains but nearly 2 grains of common salt, and in all 4 constituents; the Trafalgar Square well water contains better than $20\frac{1}{2}$ grains of common salt, and in all 12 constituents; the well water of Messrs. Combe and Delafield contains $12\frac{3}{4}$ grains of common salt, and in all 8 constituents; and the Royal Mint well water contains $10\frac{1}{2}$ grains of common salt, and in all 9 constituents. I mention these particulars in order to make my further observations intelligible.

If water contains more than 10 grains of hardening constituents, it is termed "hard water." The Watford water as above is therefore a "very hard water," more so than the Thames water by many degrees; indeed, were it not for the impurities in solution consequent upon the London sewerage and the organic matter contained in the Thames water, the Watford water would for all purposes be very inferior to it. The Thames water, however, is essentially hard, while the water of the deep wells under London is purely soft; at the same time containing no constituents, though many but what are, upon the whole, intrinsically wholesome and necessary natural adjuncts to animal subsistence.

I have heard one of the gentlemen I have already alluded to in my last letter—and, indeed, whom I quoted by way of illustrating the subject—adduce the difference in the properties of the chalk water raised respectively at Bushey Mead, near Watford, and at London, in support of his advanced theory, that the rain which falls on the denuded surface of the chalk in Hertfordshire passes directly away through deep subterraneous fissures into the sea, and that it does not percolate into the depths of the chalk formation beneath London; and that the water in the deep wells in London is some other, and for the

most part sea, water. Other gentlemen, as I have before intimated, also argue that the water in the depths of the chalk under London is impregnated with sea water. I will endeavour to show the amount of value to be attached to the views, or rather the theory of these gentlemen respectively. With respect to the former advancing as a fact, that the rain which falls upon the exposed surface of chalk in Hertfordshire, percolating down into deep subterraneous fissures, and through them passing away into the sea, I will simply say, that if such was really the case, it is very remarkable, indeed quite incomprehensible, because quite opposed to all the received and acknowledged principles of hydrostatics, that if there is a great vent—a direct outlet—below, or rather in the depths of the chalk, that water should rise, in fact gush out upon the surface, and form the innumerable springs and many rivers which are witnessed within the inclinations of the exposed portion of the chalk formation—if these subterraneous passages did exist, it is certain, beyond all cavilling, that neither springs nor rivers would be manifest on the surface of the chalk basin, nor should we have any supply of water in the chalk formation beneath London. Indeed, these immense deep fissures—for immense it is said they are—would act as a perfect system of drainage to the upper portion of the chalk formation, and the rain falling thereon would, by its own gravity, make its exit through those immense subterraneous fissures. We have, however, self-evident facts, which in themselves at once destroy the presumption that such fissures do exist. We have water in the chalk formation beneath London in abundance; and we have also springs and rivers in superabundance on the surface within the inclinations of the chalk formation, which would otherwise be subjected to the influence of the universal drainage such subterraneous outlets would most positively involve. Even the London (Watford) Spring Water Company virtually assert as a body that no such subterraneous fissures exist, for they say they can obtain any quantity of water, even eight millions of gallons per diem, from Bushey Mead; yet, strange to say, one,

I may say the principal, advocate for the success of the company in obtaining its desired powers from parliament, advances the hypothesis I have alluded to, in direct opposition to the very scheme he himself has so much interest in supporting.

The rain, as it naturally falls, is a distilled water. The atmospheric gases are supposed to be composed of one-fifth of oxygen and four-fifths of nitrogen, and as the rain descends in its pure state it takes up a larger portion of oxygen than nitrogen; and as it so falls upon and into the earth it converts carbonaceous matter into carbonic acid, the latter rendering the water capable to dissolve lime, and so a solution of carbonate of lime is produced. The longer, therefore, the water is exposed to the atmosphere the more oxygen gas will be involved, till saturation is complete, and, consequently, become more powerful to produce carbonic acid; and as an increased proportion of carbonic acid is taken into the water the more powerfully will it act upon and hold more lime in solution—thus the carbonate of lime will increase in quantity, and, the latter being a hardening constituent, the hardness of the water will proportionately increase.

The reason why the water of the chalk is so much harder at Bushey Mead, near Watford, than in the depths of the structure under London is very simple, and, consequently, very apparent. The water at Watford is taken from the surface fissures of the chalk, or rather in a declivity, or surface vale; it therefore follows that a portion of the rain which falls upon the upper portion of the vale flows down the surface, and enters the fissures in the declivity and in the vale. Such portions of the rain which so flows over or down the surface, is exposed a longer time to the atmosphere than that portion which percolates immediately into the fissures of the chalk, where it directly faces; the rain which therefore falls and flows over the surface being longer exposed to the atmosphere by the agency of the oxygen gas it contains, involves more carbonic acid, dissolves more lime, and holds more carbonate of lime in solution, than the rain water, which immediately penetrates the chalk

formation, and descends into its depths—hence the water is hard at Watford and soft under London; at which latter place, however, it varies in respect to its degrees of hardness in every deep well, in proportion to the time the rain water has been exposed to the atmosphere, more or less, before it penetrates the upper or exposed surface of the chalk.

It may be here asked, if this is really the case, how is it that this Watford water when collected in a tank becomes soft by exposure to the atmosphere? I simply say, because the oxygen in the water has no more carbonaceous matter to act upon, consequently no more carbonic acid is involved, and that carbonic acid which it already contains escapes, and the lime held thereby in solution precipitates, and the water becomes soft; but if the same water is again allowed to act upon lime, it will again become hard—even harder than ever.

With respect to the saline constituents of the chalk water differing so much in different wells, the cause is as simple as the process of hardening by the naturally produced agency of carbonic acid, though the latter has no effect whatever on the soluble salts contained in the chalk water.

It will be perceived that in the Watford water there are only two soluble constituents—a little chloride of sodium, and a little carbonate of iron—while in the water in the chalk formation under London, in three different places, the soluble constituents range from six to ten in number. The reason is this: the Watford water travels no distance through the chalk formation, and consequently does not come in contact with similar substances as the rain water, which travels a greater distance through the chalk, and thereby comes in contact and takes up the numerous soluble salts contained therein;—hence it is found that the rain water in every deep well in London, which has percolated down from the exposed surface of the chalk, differs in the quantity and number of its constituents, more or less, according to its velocity through or over the different substances it has acted upon and dissolved in its varied course through the chalk,—the chemical properties and quantities of such substances

being as diffused and as varied as the mind can imagine from the deposits of an ebbing sea.

Before any deep borings were made, or any pumping from the sand and chalk formations commenced, undoubtedly they were, as stated in my last letter, both charged with water; and the natural outlet or lip of the formation being only of a given depth, at a given point of the chalk deposit—the retiring course of the tertiary ocean—the motion of the water contained in the depths of such deposit, below the level of its outlet, has been very partial; while its drift above the level of its outlet has been according to the force of its own gravity. The lower water, *i. e.*, the water contained in chalk below the outlet or lip of the basin, will be found to be more strongly impregnated with saline constituents—the original deposits of the tertiary seas—than the water therein will be when constant abstraction shall have occasioned a larger and more rapid repleting current from the exposed surface of, and through the formation. The saline constituents of the chalk water, as now discovered, will continue to exist in a greater or lesser amount according to the stagnated condition of the water in the depths of the structure. As the water is more frequently changed by abstraction and repletion the amount of its saline constituents will diminish, and the purer it will continually become. The above analysis of the water, as contained in the deep well at Trafalgar Square, was made two years ago. In a recent analysis of the water, as now being raised from the same well, the saline constituents have diminished in amount. The quantity of carbonate of lime is reduced to 1.8 grain, indicating a more rapid descent from the surface, which has undoubtedly been occasioned by the enlargement of the fissures of the chalk by the continual friction of the water which now flows to the bore pipe of the well in greater abundance than it did when the works were first constructed.

In reference to the water of the chalk being highly chalybeate as is supposed it is in some of the deep wells, I do not believe that such is really the case to any sensible or depre-

ciable extent any where. It was rumoured that the water as raised from the well sunk at the Euston Square Railway Works, was so impregnated with mineral substances that it could not be used for every purpose ; and such was, indeed, to a very great extent, apparently quite true ; but the water so raised did not contain such properties from the chalk. In constructing the upper part of the well they had not securely stopped the surface drainage from descending into the well ; and it is well known that the substrata of and around Hampstead contains mineral properties, the drainage of which penetrated, as I have just intimated, into the well. Thus was the water, as raised from the first well constructed by the North Western Railway Company, made chalybeate. The company have since more perfectly constructed another well into the chalk, close by the first, from which they derive an abundance of wholesome water, which they supply to all their tenants ; and since their possession of such last supply, the Hampstead Water Company have lost the water supply of all the company's property.

The chloride of sodium, which is the common salt, and one of the chief of the several soluble constituents of the chalk, nature, is an original deposit of the Tertiary Seas, and is not produced from the filtration of the present sea water into the chalk formation. And with respect to the statement that the water of the deep wells under London is impregnated with sea water by the latter percolating through " the fissures which " formerly served as a partial outlet for the upper chalk water," I beg most emphatically to say that such an event is impossible unless it can be proved that such vacant fissures do really exist, or that a positive contravention of the natural laws of hydraulics takes place, and that the sea water flows out of its natural course against the hydrostatic pressure of the chalk water. It is further contended by some of the gentlemen I have had occasion to allude to, that the sea water is received into the chalk formation under tidal influence, where the chalk is otherwise denuded ; and indeed from the surface of that portion of the chalk which extends under and partially forms the bed of

the outlet of the chalk formation into the sea. Now a moment's reflection will convince the most illogical mind that by natural pressure the greater portion of the rain water falling upon the exposed altitudes of the chalk, and percolating down its fissures, more directly forces its way to the lower portions of the chalk structure; and if any outlet exists, if it be only a partial one, at any given point of the structure, the rain falling upon its upper portions will, by its own hydrostatic force, descend and rise to the level of such outlet. Hence immediately you tap the chalk fissures at Gravesend, or at any of the lower parts of the formation, beautiful soft fresh water, and not sea water, is available; even the force of this pressure is evidenced in the fresh water springs in the bed of the ocean itself at low tide; and I contend while this hydrostatic pressure continues from the elevations of the chalk formation—and continue it will, as long as the rains continue to fall—that even if the sea water flowed, as indeed it undoubtedly does, over some of the bare portion of the structure, it would not penetrate into the latter against the force and motion of the fresh water. In further corroboration of the truth of what I advance, I will add that the rain which falls upon the convexinal or external exposed portion of the London basin, *i. e.*, on the outer declivities of the circle of altitudes of the chalk formation, the inner inclinations of which I have described as the London basin—percolates through the convexinal fissures and by hydrostatic pressure is forced to the lower surface of the chalk structure which crops out round the coast, where fresh water, and not sea water, may anywhere, as at Gravesend, be obtained in abundance. And, further, if the water in the deep wells under London was sea water, the water of each well would be nearly, if not quite identical—instead of which the water in one well differs in its constituents from every other—there are no two alike.

In support of my contradiction to the assertion that the chalk water is impregnated with sea water, I beg to say that in a recent most cautiously careful analysis of the water as now

raised from the deep boring at Trafalgar Square, purposely made to ascertain whether or not sea water was present, not even a trace of iodine could be discovered, nor did it contain any sulphate of lime, both of which constituents, if indeed the chalk was impregnated with ordinary sea water, as is alleged, would most certainly have been found.

I will here just notice, although I have before indicated the same, that the same pressure which produces the springs by charging the lower surface fissures of the chalk structure, also acts at the same time in producing springs from the upper surface fissures: hence the river Thames, being in itself the natural vale of the country through which it passes, contains in its bed and in its tributaries many chalk springs, and, consequently, the constituents of the river Thames water above tidal influence, are very similar to the water direct from the chalk formation.

Upon the faith of the accuracy of the views I have now enunciated, I am bound to esteem the theories as promulgated by those gentlemen I have in the course of my correspondence alluded to, as untenable assertions, fancies of the brain, unsupported by a single known fact.

Before I conclude I will beg just to notice a paragraph of an article headed "The Institution of Civil Engineers," which has lately gone the round of the papers, referring to a discussion held at the institution here mentioned on the Rev. Mr. Clutterbuck's paper "On the Alternations and Depressions in the Chalk Water Level under London." The paragraph to which I allude is this,—"The practical conclusion to be drawn from the observations, recorded in the author's several papers were: That the natural drainage and replenishment of the chalk stratum might be traced and accounted for by observing the alternations of the level in various localities and at different seasons. That any large quantity of water abstracted from the chalk stratum, at any given point, caused a depression of level around the point of such abstraction. That in the upper district any such abstraction of water

“ would interfere with, and diminish the supply of, the streams
 “ by which the drainage of the district was regulated; and,
 “ lastly, that the depression of level under London, by pumping
 “ from Artesian wells, had proved that the rapidity of demand
 “ already exceed that of supply, and that any attempt to draw
 “ a large additional quantity for public use, would be attended
 “ with disastrous consequences.” I attended this discussion, if it
 could be so termed, and I am not aware that any such practical
 conclusion was arrived at as, “ that the depression of the level
 “ under London, by pumping from Artesian wells, has proved
 “ that the rapidity of demand already exceeded that of supply,
 “ and that any attempt to draw a large additional quantity of
 “ water for public use would be attended with disastrous conse-
 “ quences.” That Mr. Clutterbuck stated as much I admit;
 but that such a conclusion was arrived at as a practical truth,
 and as the result of the discussion, I am bound to deny: and I,
 as an individual invited to attend and take part in the discussion,
 have a right to express my deep and painful regret that such
 an unfair, delusive statement should have been sent forth for
 publication. Two or three gentlemen at the discussion sup-
 ported Mr. Clutterbuck’s views to some extent; but that any
 practical conclusion was deduced, unless it was a private one
 amongst those two or three gentlemen, is utterly untrue. And,
 in addition to the practical demonstrations constantly in opera-
 tion, I believe what I have advanced in my former and present
 communications prove beyond all power of contradiction, that
 such a conclusion cannot be truthfully substantiated. In res-
 pect to the other portion of the paragraph in question, I think
 any remarks I might have made upon it have also been given
 in my general observations on the subject.

Finally, as I commenced with the London (Watford) Spring
 Water Company, I will close with them. I object to their
 scheme because their water is very hard and unsuitable
 for all purposes; and because, if water is to be raised from
 the chalk formation, there is no necessity to go to Watford
 for it while it can be obtained in as great an abundance, and

more suitable for domestic purposes, from beneath London : but more especially do I object to it because, as I at first observed, it is brought forward under the auspices of a joint stock company, which, if tolerated, would result in the formation of another monopoly, although they now promise to charge an average rate of only £.1 upon 40,000 houses, while, according to their own showing, their working expenses will not exceed 8s. per house.

Kindly thanking you for the insertion of my letters in your important columns, I beg to remain,

SIR,

Your most obedient Servant,

JOHN LOUDE TABBERNER.

London, March 15, 1850.

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